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ABSTRACT

The Comprehensive School Mathematics Program (CSMP) is a program of CEMREL, Inc., one of the national educational laboratories, and was funded by the National Institute of Education (NIE). Its major purpose is the development of curriculum materials for grades kindergarten through 6. Two schools began using CSMP in fall 1978, with the curriculum begun with all students through fourth grade, rather than the more common grade-by-grade approach that begins with only first-grade classes. A series of tests administered in 1978, 1979, and 1980 were designed to compare the performance of students before the introduction of CSMP, after one year's experience and after two years' experience. Results indicated: 1) On MANS tests, significant improvement was found from 1978 to 1980, which was consistent with previous CSMP and non-CSMP comparisons made with the same tests; 2) The kinds of tests which the 1980 group did relatively better on were also ones on which CSMP superiority had been demonstrated in previous studies; and 3) On second-grade standardized tests, virtually no change at either school in mathematics scores related to reading scores. However, there was usually a small decrease in the first year of CSMP for third- and fourth-grade pupils, followed by a "more-than-compensating" gain the second year. (MP)

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EXTENDED PILOT TRIALS OF THE COMPREHENSIVE SCHOOL MATHEMATICS PROGRAM:

EVALUATION REPORT SERIES

ED225837

Evaluation Report 7-B-6
Student Achievement, Rapid Implementation Model

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SE 040 196

Extended Pilot Trial of the Comprehensive School Mathematics Program

Evaluation Report 7-B-6
Student Achievement, Rapid Implementation Model

Martin Herbert

December, 1980

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Description of Evaluation Report Series

The Comprehensive School Mathematics Program (CSMP) is a program of CEMREL, Inc., one of the national educational laboratories, and is funded by the National Institute of Education. Its major purpose is the development of curriculum materials for grades K-6.

Beginning in September, 1973, CSMP began an extended pilot trial of its Elementary Program. The pilot trial is longitudinal in nature; students who began using CSMP materials in kindergarten or first grade in 1973-74, were able to use them in first and second grades respectively in 1974-75, and so on in subsequent years. Hence the adjective "extended".

The evaluation of the program in this extended pilot trial is intended to be reasonably comprehensive and to supply information desired by a wide variety of audiences. For that reason the reports in this series are reasonably non-technical and do not attempt to widely explore some of the related issues. The list of reports through year six is given on the next page. The following reports are planned for year 7:

7-B-1 - Fifth Grade Evaluation: Volume I, Summary
7-B-2 - Fifth Grade Evaluation: Volume II, Test Data
7-B-3 - Fifth Grade Evaluation: Volume III, Non-Test Data
7-B-4 - Re-evaluation of Second Grade, Revised MANS Tests
7-B-5 - Achievement of Former CSMP Students at Fourth Grade
7-B-6 - Student Achievement, Rapid Implementation Model

Extended Pilot Trials of the
Comprehensive School Mathematics Program

Evaluation Report Series

Evaluation Report 1-A-1	Overview, Design and Instrumentation
Evaluation Report 1-A-2	External Review of CSMP Materials
Evaluation Report 1-A-3	Final Summary Report Year 1
Evaluation Report 1-B-1	Mid-Year Test Data: CSMP First Grade Content
Evaluation Report 1-B-2	End-of-Year Test Data: CSMP First Grade Content
Evaluation Report 1-B-3	End-of-Year Test Data: Standard First Grade Content
Evaluation Report 1-B-4	End-of-Year Test Data: CSMP Kindergarten Content
Evaluation Report 1-B-5	Test Data on Some General Cognitive Skills
Evaluation Report 1-B-6	Summary Test Data: Detroit Schools
Evaluation Report 1-C-1	Teacher Training Report
Evaluation Report 1-C-2	Observations of CSMP First Grade Classes
Evaluation Report 1-C-3	Mid-Year Data from Teacher Questionnaires
Evaluation Report 1-C-4	End-of-Year Data from Teacher Questionnaires
Evaluation Report 1-C-5	Interviews with CSMP Kindergarten Teachers
Evaluation Report 1-C-6	Analysis of Teacher Logs
Evaluation Report 2-A-1	Final Summary Report Year 2
Evaluation Report 2-B-1	Second Grade Test Data
Evaluation Report 2-B-2	Readministration of First Grade Test Items
Evaluation Report 2-B-3	Student Interviews
Evaluation Report 2-C-1	Teacher Questionnaire Data
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Evaluation Report 2-C-3	Teacher Interviews, First Grade
Evaluation Report 3-B-1	Second and Third Grade Test Data Year 3
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Evaluation Report 4-A-1	Final Summary Report Year 4
Evaluation Report 4-B-1	Standardized Test Data, Third Grade
Evaluation Report 4-B-2	Mathematics Applied to Novel Situations (MANS) Test Data
Evaluation Report 4-B-3	Individually Administered Problems, Third Grade
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Evaluation Report 5-B-1	Fourth Grade MANS Test Data
Evaluation Report 5-B-2	Individually Administered Problems, Fourth Grade
Evaluation Report 5-C-1	Teacher Questionnaire and Interview Data, Fourth Grade
Evaluation Report 6-B-1	Comparative Test Data: Fourth Grade
Evaluation Report 6-B-2	Preliminary Test Data: Fifth Grade
Evaluation Report 6-C-1	Teacher Questionnaire Data: Grades 3-5

Key to Indexing

Evaluation Reports are labelled m-X-n,

where m is the year of the pilot study, with 1973-74 as Year 1.
X is the type of data being reported where A is for overviews and summaries, B is for student outcomes and C is for other data.
n is the number within a given year and type of data.

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Summary

Two schools, one in a large Southern city and the other in a medium sized Midwestern suburb, began using The Comprehensive School Mathematics Program (CSMP) in fall of 1978. At that time CSMP was begun with all students through fourth grade rather than the more common grade-by-grade approach beginning only in first grade.

A series of tests was administered in the spring of 1978, 1979 and 1980. The purpose was to compare, at a given grade level, the performance of students: before the introduction of CSMP (1978), after a year's experience with CSMP (1979), and after two years' experience with CSMP (1980). The tests were administered in grades 2-4.

The main results were the following:

- On the MANS tests, a series of tests designed to assess some of the underlying processes of CSMP without using any of the special terminology or problem situations of the curriculum, there was from 1978 to 1980 significant improvement at every grade level and this improvement was very consistent with CSMP-non-CSMP comparisons made previously with the same tests.

- At second grade this improvement took place in the first year, from 1978 to 1979, with no further change from 1979 to 1980. At third and fourth grades, there were modest gains the first year and further gains the second year.

- The kinds of tests on which the 1980 students did relatively best - number relationships, mental arithmetic and estimation - were also the ones for which there had been a demonstrated CSMP superiority in previous studies.

- On standardized tests, at second grade, there was virtually no change at either school in math scores relative to reading scores. At third and fourth grades there was usually a small decrease in the first year of CSMP followed by a more-than-compensating gain the second year; scores on the Concepts tests always increased relative to Computation scores.

Setting

Concurrent Implementation

The Comprehensive School Mathematics Program (CSMP) is a K-6 math curriculum developed with the expectation that it would be introduced in schools on a sequential basis, one grade at a time. This has usually been the case, but occasionally schools have decided to begin the program in several grades concurrently, the intent being to compress the implementation effort into a single year of concentrated effort. The present study was an attempt to investigate student achievement in two schools which opted for this "concurrent implementation" model.

Participating Schools

In the fall of 1978, two schools began using CSMP, for the first time, as their math curriculum for all students, grades K-4. Brief descriptions of these two schools are given below.

School A:
- an inner city school in a large southern city
- a large school, grades K-6 with 150-200 students per grade level
- student and teacher population virtually all black
- rather low student achievement; mean percentile ranks of 35-40 on standardized achievement tests
- used two resource teachers, paid for by a state grant, to train teachers in the regular classrooms over the course of the year

School B:
- a school in an older suburb of a large midwestern city
- a medium sized school, grades K-5, with 70-90 students per grade level
- student population mostly white, though the district is more than 50% black
- generally very high student achivement; mean percentile ranks of 75-85 on standardized achievement tests

First graders in both schools used the regular first grade CSMP program. Second and third graders began with a series of special introductory lessons, then moved fairly quickly into the regular programs. Fourth graders spent the first semester on the fourth grade entry module, which was developed especially for classes of students beginning the program in fourth grade; consequently these students did not begin the regular first semester's work until the second semester and would remain a semester behind in later grades.

Testing Plan

A series of tests was administered on three occasions to all students[1] in grades 2-4:

spring, 1978 - The students had no CSMP experience.
spring, 1979 - The students were completing their first year of CSMP.
spring, 1980 - The students were completing their second year of CSMP.

It was then possible to compare the achievement of students at a given grade level. For example, the achievement of second graders in 1978 (no CSMP experience) could be compared with that of the next year's second graders in 1979 (one year of CSMP) and with the achievement of the following year's second graders in 1980 (two year's experience).

Three kinds of tests were used:

a) The math subtests of whatever standardized tests were routinely used by the district. This data was provided by the respective school districts.

b) The MANS tests, a series of short test scales designed for previous evaluation studies by CEMREL's Mathematics Research and Evaluation Studies program.[2] Most of these tests were intended to assess some of the underlying thinking skills of CSMP without using any of the terminology or problem situations of the program. They were administered by specially trained testers.

c) The reading comprehension test of standardized test used by the district. The data from these tests served as an indicator of whether or not the various groups of students to be compared were of similar ability levels; in addition these scores could be used as covariates in the analysis of the other test data.

[1] Third graders in School B were not tested in 1980

[2] See Evaluation Reports 3-B-1, 4-B-2 and 5-B-1 for descriptions of tests and test results for the original administration of these tests.

Second Grade Results

MANS Tests

For each class, a mean raw score was calculated for each MANS Test. Brief descriptions and summary data for these individual scales are given in Appendix A. The Total MANS score for each class was also calculated and plotted against the corresponding mean score in reading. Different reading tests were used in the two schools; furthermore School B changed standardized tests after the first year. Hence, all reading scores were converted to percentile ranks for the graph in Figure 1, below.

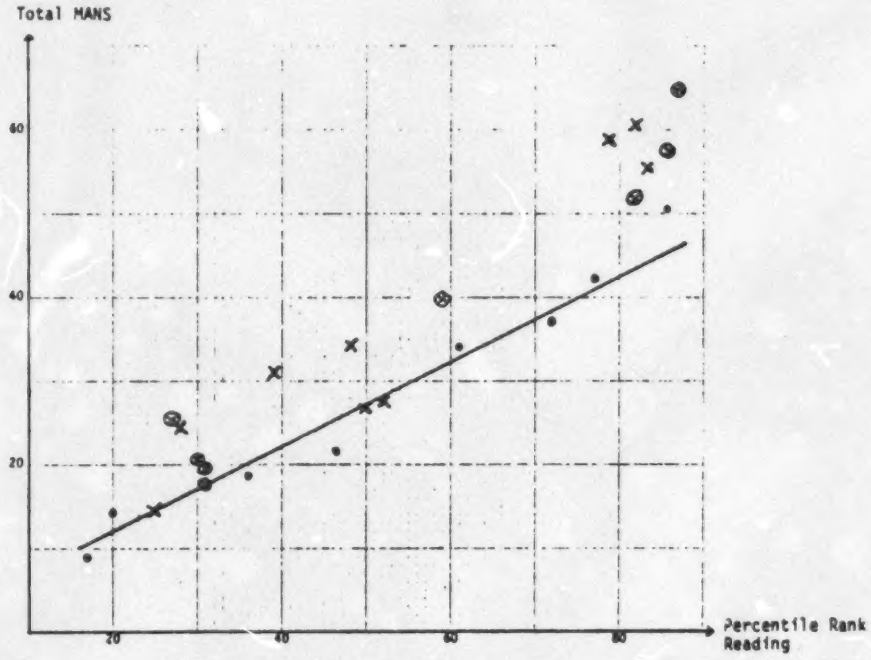


Figure 1, Graph of Class Means for Second Grade Total MANS
• = 1978 class, x = 1979 class, ⊗ = 1980 class

It can be seen from the regression line which has been drawn on the graph that there is a trend for the 1979 and 1980 classes to have higher scores relative to their ability level (i.e. above the regression line for the 1978 classes). There appears to be no difference between the 1979 and 1980 classes. Thus with the introduction of CSMP in 1979 there was an immediate improvement, but the 1980 group, which had the benefit of studying CSMP in first grade as well, did not make further improvement.

This result can be illustrated in a different way. For each school the mean score across classes each year was calculated and graphed together with mean scores from other districts who had participated in the original evaluation with these tests. These other districts had adopted CSMP in the usual year-by-year way, and for them, the comparison was with similar non-CSMP classes in the district. This graph is shown in Figure 2, below, with the common regression line.

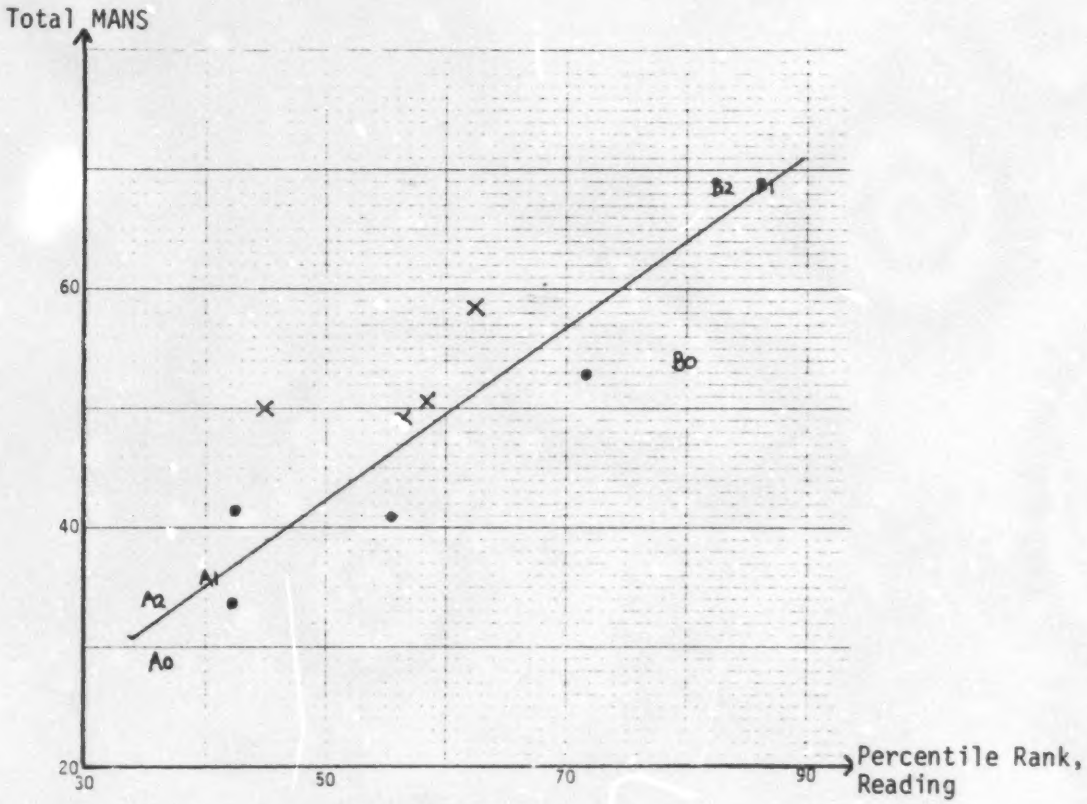


Figure 2, Second Grade MANS Scores, Present Study Plus Previous Data

A0, A1, A2 = School A in 1978, 1979 and 1980 respectively

B0, B1, B2 = School B in 1978, 1979 and 1980 respectively

x = CSMP District (previous study)

● = non-CSMP District (previous study)

Figure 2 shows that the data from the present study agree with the previous data rather well (based on the common regression line) if one simply considers the 1978 testing as "Non-CSMP" and the 1979 and 1980 testings as "CSMP". It also shows again that there is virtually no difference in the scores from 1979 and 1980.

Thus the pattern of results in these two schools was remarkably similar to results obtained previously in which there was a significant advantage for CSMP classes. Significance tests were not calculated in the same way in the present studies because of the small number of classes and different reading measures. When analysis of covariance was used with student as the unit of analysis - perhaps an inappropriately liberal method - gains on the total and on almost all the individual scales were significant at both schools from 1978 to 1979, but not from 1979 to 1980.

However, although the pattern of total score gains was similar, there were some differences with respect to individual scales. Two scales dealing with the production of multiple answers, or fluency (A2, Equation Fluency and B1, Number Sentences), produced the largest gains but neither was significant in the original study. On the other hand, two scales dealing with the easy computation of large numbers produced small and irregular gains in the present study compared with large and significant differences in the original study. Appendix A gives the school means for each scale used in the second grade.

Standardized Test Data

At School A, the Comprehensive Test of Basic Skills battery was administered each year as part of the regular district testing.

A mean score for each class was calculated for the math subtests and for the total reading test and converted to a percentile rank. The mean across classes for each of the various tests is given in Table 1, below.

Table 1

Mean Percentile Ranks, School A

Second Grade Comprehensive Tests of Basic Skills

Year	Reading	Math Computation	Math Concepts	Total Math
1978	35.0	58.0	35.2	46.4
1979	40.2	55.4	44.8	51.0
1980	38.2	52.0	44.5	48.3

For all years, the percentile for Total Math is about 10 points more than for Reading. Over the course of the two years there has been a small drop in Computation scores and an increase in Concepts scores.

At School B, the Stanford Achievement Test was administered in 1978, but the California Achievement Test was used in the district in 1979 and 1980. Thus, norm data from these two tests are not directly comparable. Table 2 presents the mean scores on these tests.

Table 2

Mean Percentile Ranks, School B
Second Grade Standardized Tests

Year of Testing	Total Reading	Computation	Concepts
1978 (Stanford Achievement Test)	78.5	72.7	82.3
1979 (California Achievement Test)	81.3	79.4	80.6
1980 (California Achievement Test)	85.0	81.6	88.0

Because of the change in tests, and because of the very high scores (with potential ceiling effect) on all tests, it is difficult to evaluate any changes in the data. Computation scores remain slightly lower and Concepts slightly higher than the corresponding Reading scores.

Third Grade Results

MANS Tests

Figure 3, below, shows the graphs of mean class scores on the Total of the MANS scales versus percentile rank in reading. It should be noted that these tests were not administered in 1980 at School B; hence there are no ⊗'s in the upper right corner of the graph.

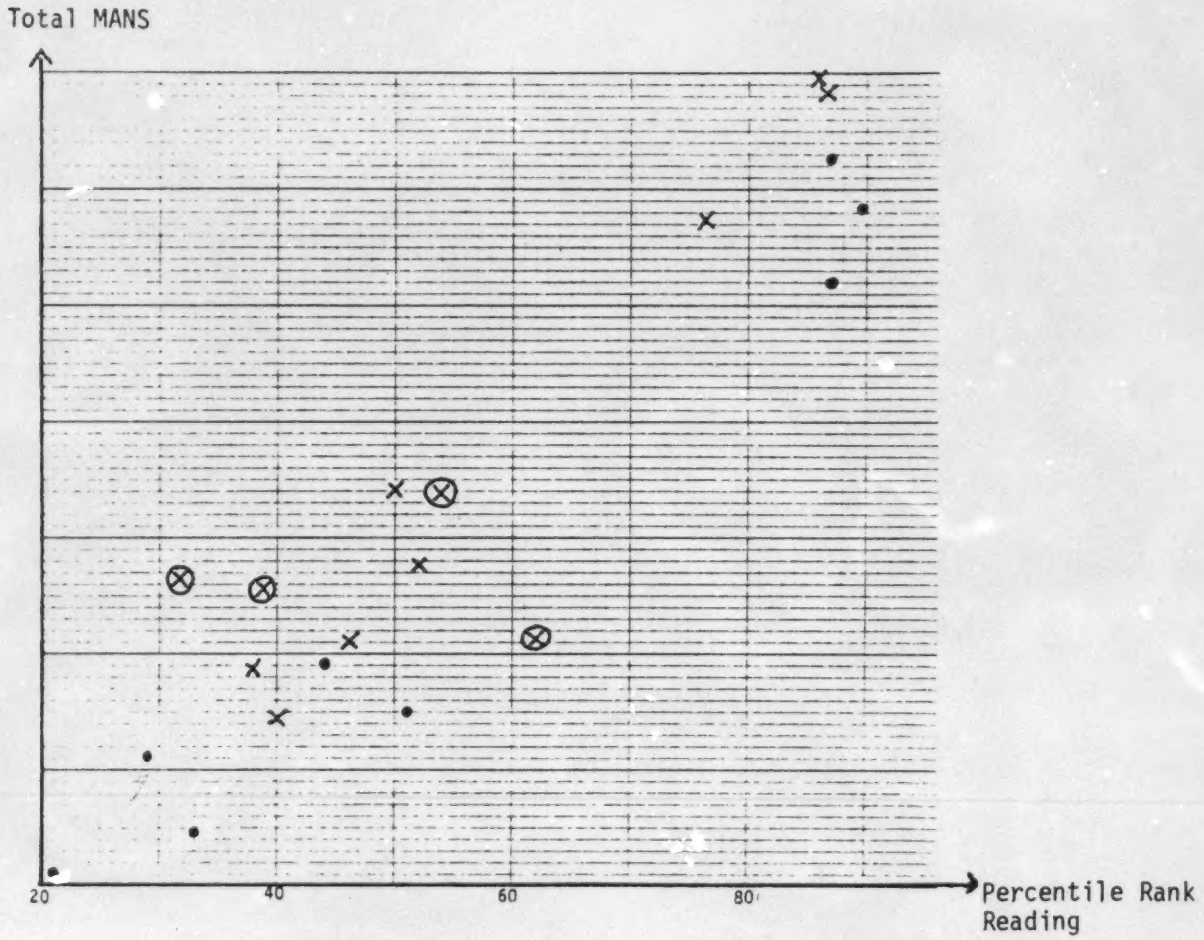


Figure 3, Graph of Class Means for Third Grade Total MANS
● = 1978 class, x = 1979 class, ⊗ = 1980 class

At both sites there has been an improvement in scores from year-to-year. At school A this effect is lessened somewhat in 1980 by one low scoring class: particularly low relative to its reading ability. Furthermore, there is no regression line that adequately fits the data at both schools.

In Figure 4, the school means are graphed together with means derived from previous studies, and a common regression line.

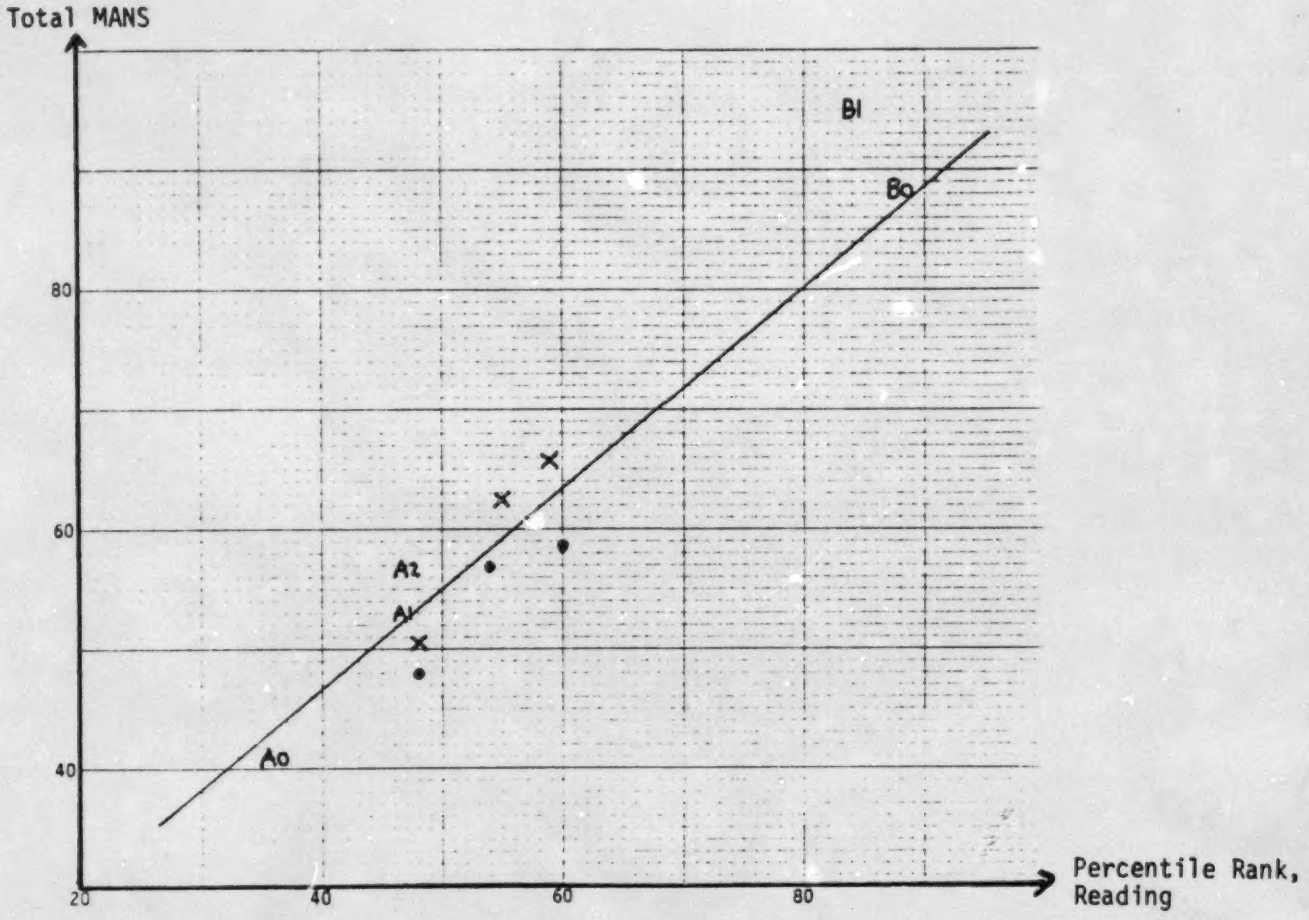


Figure 4, Third Grade MANS Scores, Present Study Plus Previous Data
A0, A1, A2 = School A in 1978, 1979 and 1980 respectively
B0, B1, B2 = School B in 1978, 1979 and 1980 respectively
x = CSMP district, ● = non-CSMP district - previous study

School A fits the previous data fairly well; a small gain after a year of CSMP (from A0 to A1) and a further gain the second year (A1 to A2). Unlike the second grade where there was a healthy gain in the first year and none after another year, it appears that by the end of third grade, students who started the program at third grade do better than non-CSMP third graders, but less well than third graders who started the program a year earlier in second grade.

At Site B there was a large gain (larger than at any other site) after just a year's use of CSMP.

The pattern of gains on individual scales in Schools A and B was similar to the pattern in the original study. On the four scales in which significant differences were not previously found, there were again very small differences except for one scale at one school. On the remaining 10 tests on which there were again corresponding gains for eight of the ten at each of the two schools. Appendix B gives the school means for each scale used in the third grade.

Standardized Test Data

For School A, the percentile ranks corresponding to the mean across classes on the Comprehensive Tests of Basic Skills are shown in Table 3, below.

Table 3
Mean Percentile Ranks, School A
Third Grade Comprehensive Tests of Basic Skills

Year	Reading Comprehension	Math Computation	Math Concepts	Math Applications	Math Total
1978	44	55	37	36	45
1979	56	63	54	38	58
1980	57	67	57	44	64

It can be seen that Total Math scores improved slightly more than Reading scores between 1978 and 1980, and that, of the individual math subtests, the Concepts test showed the largest gain.

Table 4 shows mean percentile ranks on the standardized test data from School B. Data was not collected in 1980.

Table 4
Mean Percentile Ranks, School B
Third Grade Standardized Test Data

Year and Name of Test	Reading	Math Computation	Math Concepts	Math Applications	Math Total
1978 (CTBS)	88.0	88.5	88.2	86.5	89.4
1979 (CAT)	83.1	79.9	86.8	——	84.8

The decline in Reading and Total Math scores (possibly a result of the change in tests and their respective norms) was very similar; relative to Reading scores, there was a decrease in Computation scores and an increase in Concepts scores.

Fourth Grade Data

MANS Tests

At School A, it was necessary to administer the third grade MANS tests to the fourth graders (the fourth grade scales not being available by the testing date at School A).

The mean scores on the totals of these MANS Tests were:

1978: 48.8, 1979: 60.9, 1980: 64.9

When the scores are adjusted for differences in reading ability from year-to-year, the scores go from 48 to 59 to 67, i.e. large gains in each of the two years.

Figure 5 shows the class means for each of the three years on the total of the MANS scales. Relative to the regression line for the 1978 classes, scores are higher in 1979 and again in 1980.

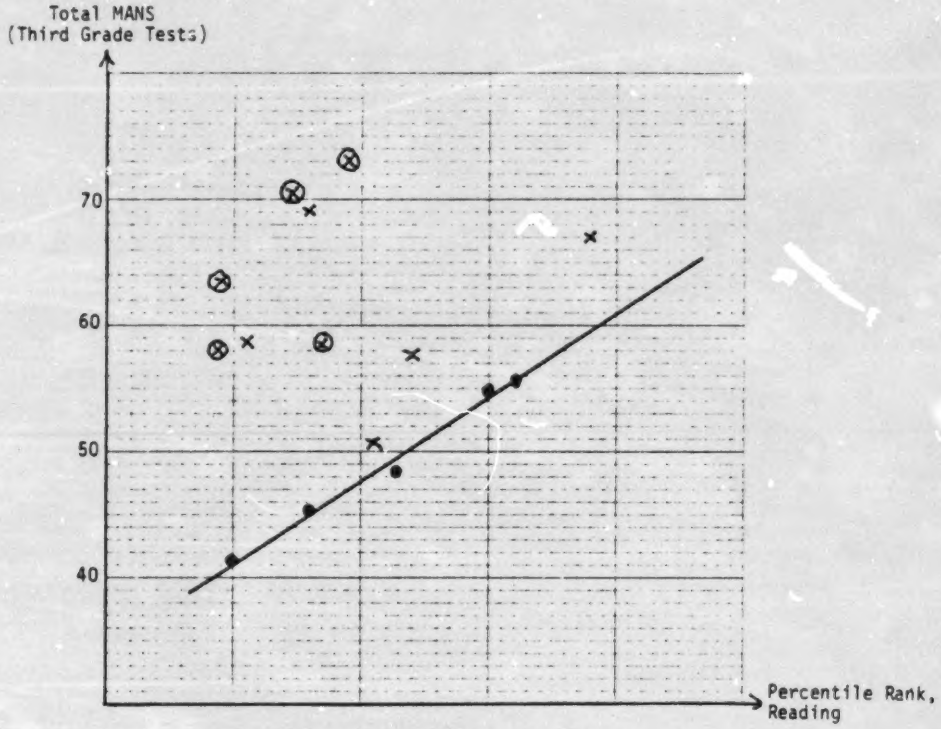


Figure 5, Mean Scores on Third Grade MANS Scores

●, x, ⊗ = 1978, 1979, 1980 Fourth Grade Class Means, School A

At School B, on the regular fourth grade MANS tests, the mean scores increased from 123.4 to 141.7 to 150.4. These mean scores are plotted in Figure 6, below, along with various class means from the previous study.

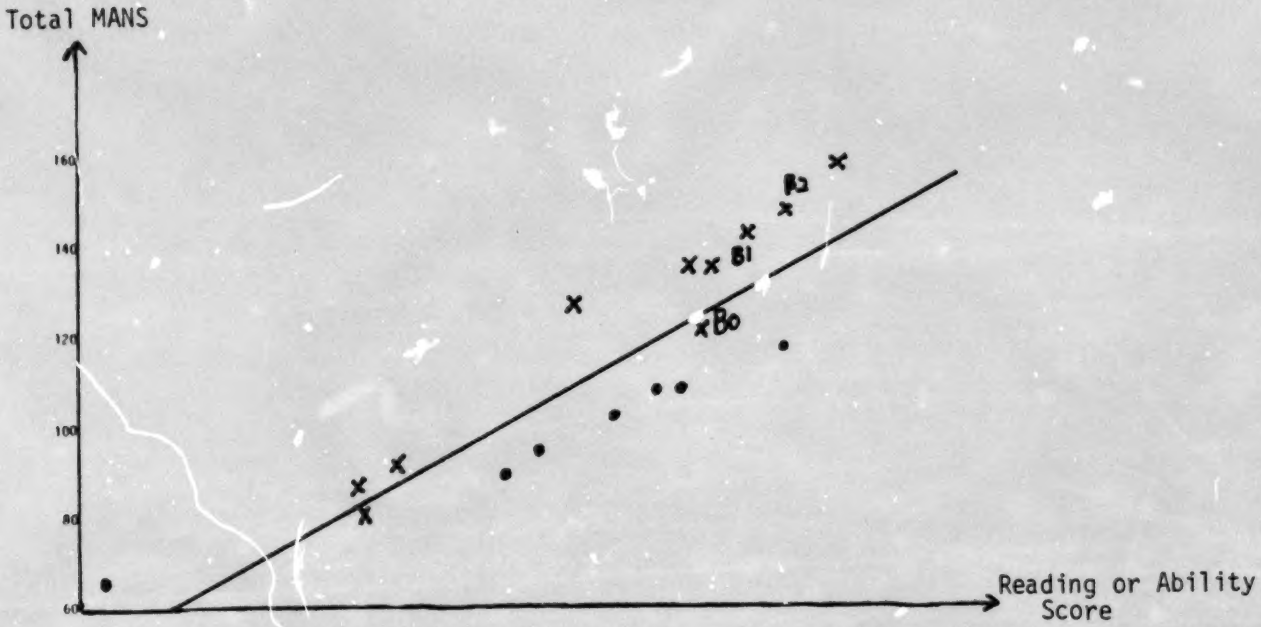


Figure 6, Fourth Grade MANS Scores, School B

BO, B1, B2 = School B means for 1978, 1979, 1980 respectively

x = CSMP Class, • = Non-CSMP Class - previous study

The pattern of gains at School B from 1978 to 1980 was very similar to the pattern of CSMP-non-CSMP differences recorded in the earlier study. For 17 scales there were significant or nearly significant differences on each occasion and on 5 scales there were virtually no differences on either occasion. School B in 1980 did relatively better than previous CSMP classes on a computation scale with division and on an estimation scale which also used a division process.

Standardized Test Data

Mean Standard Scores across classes at School A are given in Table 5 below.

Table 5
Mean Percentile Ranks, School A
Fourth Grade Comprehensive Tests of Basic Skills

Year	Reading Comprehension	Math Computation	Math Concepts	Math Applications	Math Total
1978	405	391	391	370	386
1979	407	389	383	362	376
1980	387	390	410	379	387

From 1978 to 1979, with little change in Reading scores, there was a small decline in each of the Math scores. But in 1980, with a large drop in Reading scores, there were gains in Concepts and in Applications. If scores were adjusted for Reading ability, these gains would have been equivalent to about 10-15 percentile ranks from 1978.

Standardized test data from fourth grade, School B, is summarized in Table 6, below.

Table 6
Mean Percentile Ranks, School B
Fourth Grade, Standardized Tests

Year (Test)	Total Reading	Math Computation	Math Concepts	Math Total
1978 (CTBS)	79.0	78.7	78.9	79.4
1979 (CAT)	82.2	74.9	81.1	79.3
1980 (CAT)	86.9	83.2	89.1	88.4

At School B, there were very small changes in Math scores relative to Reading, though there was again a tendency for scores to drop the first year of CSMP (1979) and to increase the next year. Again, after CSMP, Computation scores tended to be lower and Concepts scores higher than Reading scores.

Appendix A

Second Grade MANS Scales and School Means[1]

The means for each scale are given for Schools A and B for 1978, 1979 and 1980 on page 19.

MANS A

Subtest 1: Sequences The crucial directions were, "The numbers are in a certain order...figure out what the pattern is...put the right number in the box."

Example: 16, 13, 10, ☐, 4, 1

Subtest 2: Equation Fluency The crucial directions were, "...write as many true number sentences as you can, using only these signs and numbers." = + - x 1 2 3

Example: 3 - 1 = 2

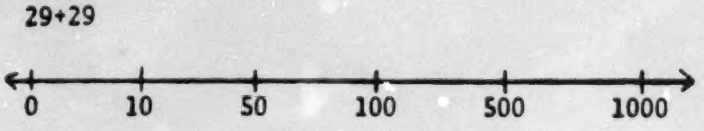
Subtest 3: Functions The crucial directions were, "A teacher was playing a game with the class...a student gave her 2 (the first number of each pair), she did something to it and got 4 (the second number) ...figure out what it was that the teacher was doing to the numbers, and then put the right number in the empty box."

Example:

2	4
5	10
7	14
10	

Subtest 4: Number Line Estimation The crucial directions were, "This is a funny looking number line isn't it? ...there are a whole lot of problems (13) and you won't have much time (2½ min.) to do them. You should not try to calculate the exact answer; just decide quickly where the answer would probably go on the number line."

Example:



Subtest 5: Computation The crucial directions were, "...figure out what goes in the boxes to make the number sentences true."

Example: ☐ - 49 = 0

[1]See CSMP Evaluation Report 4-B-2 for a fuller description of these tests and the results from the CSMP-non-CSMP comparison involving 55 classes.

MANS B

Subtest 1: Labelling Number Lines The crucial directions were, "...figure out what number would go in the box on each number line." (Note to reader: no student did both this subtest and Subtest 4 of Booklet A in which the number line was not equal-interval.)

Example:

Subtest 2: Number Sentences The crucial directions were, "Write number sentences for 8...write as many as you can think of."

Example: 8 = 6 + 2 _____

Subtest 3: Word Problems The crucial directions were, "For each series of pictures there is a story. At the end of each story there is a question you will be expected to answer."

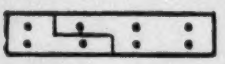
Example: "First picture, 'Four children each get the same allowance from their mother.' Second picture, 'The four children put their allowances together.' Third picture, 'They have altogether 12 dollars.' Question, 'How much did each child get?'"

(Note to reader: while the above information was being read to the students, the student's test page contained the pictures below.)

How much did each child get? ____

Subtest 4: Number Sentence Pictures This was a "matching" task; four equations on one side of the page and five dot pictures on the other side. The crucial directions were, "figure out which dot picture shows (each) number sentence best...there are five pictures and only four number sentences...make up a number sentence that goes with the picture that's left over."

Example: 5+3=8



Subtest 5: Computation (Same directions as Subtest 5 in booklet A but different items.)

School A, Second Grade MANS Mean Scores

	1978	1979	1980
Mans Test A			
A1: Sequences (6 items)	1.2	1.8	1.8
A2: Equation Fluency	2.5	4.7	4.2
A3: Functions (5 items)	0.9	1.2	1.3
A4: Number Line Estimation (13 items)	3.5	3.5	4.0
A5: Computation I (12 items)	4.4	5.2	4.9
MANS Test B			
B1: Labeling Number Lines (8 items)	3.3	3.8	4.1
B2: Number Sentences	1.9	3.4	2.9
B3: Word Problems (7 items)	2.5	3.1	3.2
B4: Number Sentence Pictures (9 items)	3.2	4.2	3.9
B5: Computation II (12 items)	4.1	5.5	4.2
Total MANS	27.6	36.7	34.5

School B, Second Grade MANS Mean Scores

Test	1978	1979	1980
A1: Sequences (6 items)	3.9	4.7	4.9
A2: Equation Fluency	3.9	7.5	6.9
A3: Functions (5 items)	3.0	3.8	3.5
A4: Number Line Estimation (13 items)	5.7	7.7	7.5
A5: Computation I (12 items)	7.9	9.7	9.8
B1: Labelling Number Lines (8 items)	6.1	6.9	7.1
B2: Number Sentences	3.9	6.7	6.0
B3: Word Problems (7 items)	5.2	5.4	5.4
B4: Number Sentence Pictures (9 items)	5.5	7.3	6.9
B5: Computation II (12 items)	8.4	9.1	9.5
Grand Total	53.7	68.8	67.5

Appendix B

Third Grade MANS Scales and School Means[1]

The means for each scale are given for Schools A and B for 1978, 1979 and 1980 on pages 24 and 25. Then, on page 26, the means for School A, fourth grade, are given.

SCALE A1: **Height and Weight Table (6 items)**

ABSTRACT: **Read and interpret data from a table of students' weights and heights for two different years**

SAMPLE: **Who stayed the same height?**

SCALE A2: **Estimation (25 items)**

ABSTRACT: **Quickly estimate which of 5 standard intervals contains the answer to each of a series of computation problems. Three separate pages containing 8 addition, 8 subtraction and 7 multiplication problems respectively.**

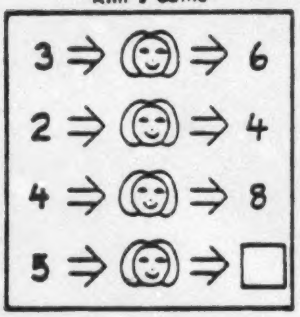
SAMPLE: 100 - 93 0 10 50 100 500 1000

SCALE A3: **Functions (8 items)**

ABSTRACT: **For each of several problems, determine from 3 pairs of numbers what the "secret rule" is which produces the second number from the first and use it to find the missing number from the 4th pair.**

SAMPLE:

Kim's Game



SCALE A4: **Two Stage Word Problems (5 items)**

ABSTRACT: **Word problems (printed in booklet and read by tester) in which two different operations must be performed and where the numbers in the given data are relatively small.**

SAMPLE:

Our hens lay 9 eggs every day.

Each day we eat 6 of them and give the others away.

During the next 3 days how many eggs will we give away? _____

[1] See CSMP Evaluation Report 4-B-2 for a fuller description of these tests and the results from the CSMP-non-CSMP comparison involving 55 classes.

* SCALE A5: Large Number Computations (12 items)

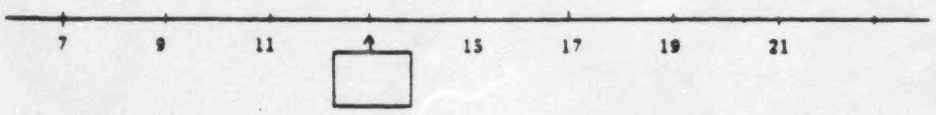
ABSTRACT: Solve computation problems given in an open sentence format, with the boxes sometimes in non-standard positions, and with numbers in the hundreds but relatively easy to work with (addition, subtraction and multiplication).

SAMPLE: 500 + ☐ = 800

SCALE A6 Number Line Labelling (8 items)

ABSTRACT: Label the indicated "mark" on several number lines, where marked intervals vary from item to item and where other marks are irregularly labelled.

SAMPLE:



SCALE A7: Hints and Problems (5 items)

ABSTRACT: Quickly complete a given addition problem by using the answer to another problem where one addend is the same as, and one is only slightly different from the given problem.

SAMPLE: Hint: 537 + 293 = 830

537 + 283 = ☐

SCALE B1: 2 or 5 or 10 (10 items)

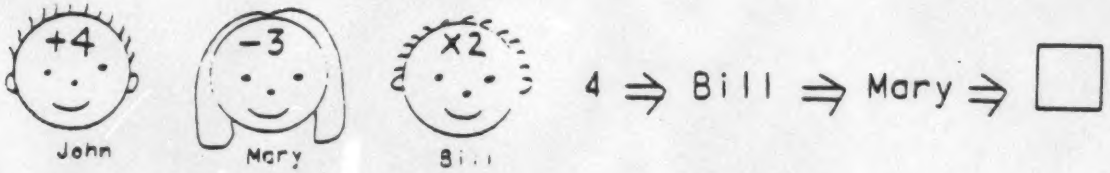
ABSTRACT: Quickly estimate whether a given number is about 2 or 5 or 10 times as large as another given number.

SAMPLE: 60 is about ____ times as large as 31

SCALE B2: Composite Functions (9 items)

ABSTRACT: Starting with a given number, apply one or more operations in sequence and determine final result. Also, same process except final result is known and starting number is to be determined.

SAMPLE:



SCALE B3: Equation Fluency

ABSTRACT: Given the symbols: = + - x 1 2 3 ( ), construct as many different equations as possible

SAMPLE ANSWER: 3 - 1 = 2

SCALE B4: Circle the Larger (13 items)

ABSTRACT: Given pairs of computation problems, quickly determine which one has the larger answer.

SAMPLE: 371 + 248 370 + 258

SCALE B5: Missing Digits (8 items)

ABSTRACT: Given a computation problem with one or two digits of the problem crossed out, determine whether or not the given answer could have been right (before the digits were crossed out).

SAMPLE:

54
×3■■
500

Could 500 be the answer?

No, 500 is too small. ☐
Yes, 500 could be right. ☐
No, 500 is too big. ☐

SCALE B6: Word Problems with "Rounding" (5 times)

ABSTRACT: Solve word problems (printed in booklet and read by the tester) involving division in which the given numbers do not divide evenly - i.e., the answer, which must be an integer, can be obtained by rounding the obtained quotient up or down. The numbers of the given data were relatively small.

SAMPLE:

An elevator can't hold more than 5 people.

23 people want to ride to the top floor.

How many times will the elevator have to go up? _____

SCALE B7: Fractions (8 items)

ABSTRACT: Solve problems of the form x of y = ☐ or x of ☐ = y where x is 1/2 or 1/3.

SAMPLE: $\frac{1}{2}$ of 12 = ☐

School A, Third Grade MANS Mean Scores

	Third Grade		
	1978	1979	1980
MANS Test A			
A1: Height & Weight Table (6 items)	2.2	2.5	2.4
A2: Estimation (25 items)	6.4	7.8	8.9
A3: Functions (8 items)	1.1	2.6	2.2
A4: Two Stage Word Problems (5 items)	1.2	2.0	2.4
A5: Large No. Computation (12 items)	2.9	4.0	2.8
A6: Number Line Labeling (8 items)	2.2	3.4	3.0
A7: Hints and Problems (5 items)	0.8	1.5	1.3
MANS Test B			
B1: 2 or 5 or 10 (10 items)	4.5	4.6	5.4
B2: Composite Functions (9 items)	3.1	4.4	5.1
B3: Equation Fluency	3.5	5.2	8.3
B4: Circle the Larger (13 items)	6.7	7.4	7.5
B5: Missing Digits (8 items)	2.7	2.8	2.8
B6: Word Problems Rounding 95 items)	1.0	1.2	1.3
B7: Fractions (8 items)	1.7	2.9	3.1
Total MANS	40.5	52.7	57.4

School B, Third Grade MANS, Mean Scores

Test	1978	1979
A1: Height and Weight Table (6 items)	5.1	4.8
A2: Estimation (25 items)	12.8	15.0
A3: Functions (8 items)	5.8	6.4
A4: Two Stage Word Problems (5 items)	3.8	4.2
A5: Large Number Computation (12 items)	7.4	8.7
A6: Number Line Labelling (8 items)	6.1	6.4
A7: Hints and Problems (5 items)	3.0	3.3
B1: 2 or 5 or 10 (10 items)	7.2	8.0
B2: Composite Functions (9 items)	7.4	8.3
B3: Equation Fluency	8.0	7.4
B4: Circle the Larger (13 items)	9.6	10.5
B5: Missing Digits (8 items)	3.7	4.3
B6: Word Problems Rounding (5 items)	3.3	3.6
B7: Fractions (8 items)	5.1	6.5
Grand Total	88.3	97.4

School A, Third Grade MANS Tests
Mean Scores for Fourth Graders

	Fourth Grade		
	1978	1979	1980
MANS Test A			
A1: Height & Weight Table (6 items)	2.8	2.9	2.9
A2: Estimation (25 items)	8.4	9.5	10.4
A3: Functions (8 items)	1.8	2.7	3.9
A4: Two Stage Word Problems (5 items)	1.8	2.1	2.6
A5: Large No. Computation (12 items)	4.4	4.6	5.9
A6: Number Line Labeling (8 items)	3.1	3.7	4.0
A7: Hints and Problems (5 items)	1.2	1.7	1.9
MANS Test B			
B1: 2 or 5 or 10 (10 items)	4.9	5.2	5.9
B2: Composite Functions (9 items)	3.1	5.9	6.1
B3: Equation Fluency	4.1	5.6	5.7
B4: Circle the Larger (13 items)	7.2	7.6	8.1
B5: Missing Digits (8 items)	3.0	3.1	3.0
B6: Word Problems Rounding 95 items)	1.3	2.4	1.6
B7: Fractions (8 items)	1.8	3.5	2.6
Total MANS	48.8	60.9	64.9

Appendix C

Fourth Grade MANS Scales and School B Means[1]

The mean scores are given on page 32.

Computation Scales

Scales 1-4:

There were four computation scales, one in each of the basic operations, containing from 5 to 7 test items each. The format was mixed between horizontal and vertical and the difficulty ranged from basic facts to algorithms (simple two digit multiplication and one-digit division).

Word Problems

Scale #5, One-Step Word Problems. These problems involved only one operation with a low level of computational difficulty.

Scale #6, Two-Step Word Problems. A fairly typical item of this scale was the following:

> There are 40 apples in my barrel now.
> I will eat 2 apples every day.
> How many apples will be left in my barrel after 5 days.

This particular item required either repeated subtraction, or multiplication and then subtraction. Other items required different combinations of operations.

Scale #7, Hits and Misses. This scale concerned the calculation of game scores in which "hits" were worth 5 points while "misses" lost 3 points.

Scale #8, Miscellaneous Word Problems. This scale contained very simple problems involving concepts related to decimals, proportions and rounding.

[1]See CSMP Evaluation Report 5-B-1 for a fuller description of these tests and the results from the CSMP-non-CSMP comparison involving 17 classes.

Large Number Computation

Scales #9 and 10.

These two scales were composed of problems given in an open sentence format illustrated by two examples below. $\square \times 4 = 400$

$800 \div \square = 200$

The problems in Scale 9 contained either addition or division signs and the problems in Scale 10 contained either subtraction or multiplication signs. Of course the process used by the student may or may not correspond to the written sign, as in the first example above where the student might ask either "4 times what equals 400?" or "What is 400 ÷ 4?"

The numbers were easy to work with, usually multiples of one hundred or fifty.

Estimation

Scales #14a) 14b) and 14c) each contained a series of computation problems using addition, multiplication and division respectively, and the task was to determine which of several given intervals contained the answer to the problem. For example, which interval contains the answer to 2 x 49?

(0,10) (10,50) (50,100) (100,500) (500,1000)

One doesn't need to know that 2 x 49 = 98, merely that it's less than 2 x 50 = 100

Scale #16, Multiplying by 2, 5 or 10, posed several questions like the following:

"100 is about ____ times as large as 19"

where the blank was to be filled in by whichever of 2, 5 or 10 was best.

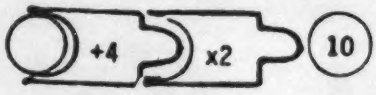
Scale #17, Which is Larger, gave a series of pairs of computation problems and in each pair the student had to select the problem which had the largest answer, for example, 38 x 38 versus 39 x 31. Altogether there were 12 test items, 4 each dealing with multiplication, division and fractions.

Number Relationships

Scale #18, Solving Number Machines, This used "machines" like the following:

The left hand circle is always for the number we started with and the right hand circle is for the number we ended up with after the machine had done its job; in this case subtracting 3. For each problem of Scale 18, an unlabelled machine was shown in operation with various pairs of inputs and outputs, and then with one of the inputs or outputs missing. The task was to figure out from the given information what the machine was doing each time, and then to figure out the missing input or output.

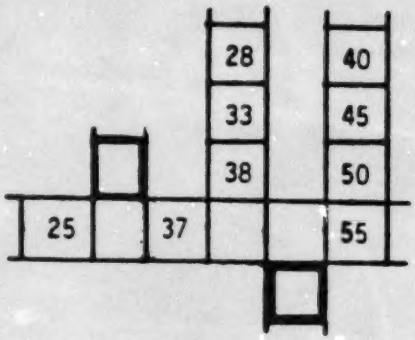
Scales #19, Using Number Machines, also used machines, but they were always labelled and usually hooked up with other machines. For example:



The task was to figure out the missing input (in this case) or output.

Scales #20a, 20b, 20c. These all dealt with "boxes", as in the "squares" of a crossword puzzle. For any given problem, the numbers are always increasing or decreasing by the same fixed amount when one goes horizontally and by some different amount when one goes vertically. A typical item from Scale 20a) asked whether 86 would ever be in one of the boxes (which extend both ways) of:

A typical item from Scale 20b) asked the students to fill in the heavy boxes in the following diagram, having been told that horizontal counting is by 6 and vertical counting is by 5.



Scale 20c) also required completion of boxes except that instead of "counting by" there was "multiplying by".

Other Scales

The remaining 5 scales did not fit into one of the previously described groups of scales.

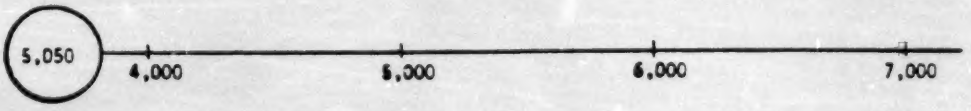
#11 Fractions: There were two kinds of items. Four items required taking $\frac{1}{2}$ or $\frac{1}{3}$ of a number; the other four items required addition or subtraction of fractions with like denominators.

#12 Measuring: In each item of this scale, a rod was shown aligned in some way with a ruler (not always starting at the zero mark). The task was to determine how long the rod was, various rulers being marked in halves, quarters and tenths of an inch. For example:

#13 Using Hints: Three very large addition and two multiplication problems were given, complete with answer. In each problem, one digit of one of the numbers in the problem was crossed out and a new one written above. The task was to figure out what the answer to the problem would now be, given this change. This was a matter of making the appropriate adjustment in the original answer. Not enough time was given to get the new answer from scratch.

#15 Labelling Number Lines: The items were of the following type:

#21 Place Value: In the items of this scale, a number line marked in either 10's, 100's, or 1000's was given and the task was to either indicate with an x on the number line approximately where a given number was located or name the approximate number located by a given x. For example:



School B, Fourth Grade MANS Mean Scores

Test	Number of Items	1978	1979	1980
Computation				
#1 Addition	5	4.5	4.5	4.7
#2 Subtraction	5	4.0	3.6	4.3
#3 Multiplication	7	5.3	5.9	6.3
#4 Division	6	3.7	4.8	5.1
Word Problems				
#5 One-Step	8	6.5	6.9	6.8
#6 Two-Step	6	3.7	4.5	4.9
#7 Hits and Misses	5	1.4	1.9	2.5
#8 Miscellaneous	6	2.5	3.6	4.2
Number Relationships				
#18 Solving Number Machines	8	6.2	7.2	7.3
#19 Using Number Machines	9	5.6	7.3	7.2
#20a) Boxes-1	9	6.4	7.5	7.6
#20b) Boxes-2	9	5.7	7.0	7.0
#20c) Boxes-3	7	2.9	4.6	5.5
Estimation				
#14a) Estimation-Addition	8	6.5	6.7	6.8
#14b) Estimation-Multiplication	7	5.0	5.8	5.8
#14c) Estimation-Subtraction	7	3.8	4.2	4.4
#16 Multiplying by 2, 5 or 10	13	9.7	9.9	10.9
#17 Which is Larger	12	8.7	9.7	9.8
Large Number Compuation				
#9 Large Number Computation (+,÷)	9	5.4	6.5	7.9
#10 Large Number Computation (-,x)	8	5.0	5.4	6.0
Other Scales				
#11 Fractions	8	5.4	6.4	6.9
#12 Measuring	6	4.0	4.2	4.4
#13 Using Hints	5	2.4	2.7	3.0
#16 Number Line Labelling	6	3.3	4.9	5.2
#21 Place Value	8	5.8	6.0	6.1
Total		123.4	141.7	150.4